Determination of Salt Content of Sauerkraut by Cation Exchange

A simple economical method is described for the estimation of sodium chloride in sauerkraut during fermentation and in the final product. Following titration of lactic acid, the sample is passed through a strong cation-exchange resin in the hydrogen form, and the effluents are titrated for the hydrogen ion exchanged from the resin. Accuracy of the method is indicated by a recovery of added sodium chloride of 93.4% and the precision by a relative standard deviation of 2.28%. The method should also have application in other fermented food processes to which salt is added.

In the processing of cabbage for sauerkraut, the acidity and sodium chloride content must be known to control the quality of the final product. The total acidity, calculated as lactic acid, is traditionally determined by titration with standard sodium hydroxide; the salt content of a separate sample is assayed by titration with standard silver nitrate (Pederson and Albury, 1969). Recent modifications (Brammell, 1971; AOAC, 1975) include potentiometric titration of chloride ion with silver nitrate. These methods give high accuracy and precision. However, the less accurate method described here is simple, requires no instrumentation, and is economical in operation because no costly silver nitrate is required. It should be useful where large numbers of determinations are required, such as in a kraut processing plant.

MATERIALS AND METHOD

Ion-Exchange Column. A glass column (100 mm × 6 mm, i.d.) is fitted with a reservoir tube (50 mm × 16 mm, i.d.) at the top and a capillary tube (10 mm × 2 mm, i.d.) at the bottom. The capillary terminates at a stopcock or a rubber tube and pinch clamp.

Cation-Exchange Resin. Analytical Grade AG 50 w × 8, 20–50 mesh, hydrogen form resin was purchased from Bio-Rad Laboratories, Berkeley, Calif. From 5 to 5 mL drained volume of the resin is poured into the column after first inserting a small glass wool plug. This volume of the exchange resin has a quantitative exchange capacity equivalent to 50 mL of 0.1 N sodium hydroxide. After regeneration with 10 mL of 10% hydrochloric acid, excess hydrochloric acid is removed from the resin column with five washes of 5 mL of distilled water before reuse. Samples that contain suspended particles may be passed through the column without filtration, but the column may require repouring because of restricted flow. After 30–40 regeneration cycles, the quantitative exchange capacity decreases slightly.

Procedure. Kraut juice (3 to 10 g) is titrated with 0.1 N sodium hydroxide (phenolphthalein endpoint, pH 7.8 to 8.5) to determine the free acidity (titration I). This titrated solution is passed through the resin column followed by five 5-mL washes to quantitatively remove the acid released from the cation exchange. Less than 5 min is required for this step. The combined effluents are again titrated to the phenolphthalein endpoint (titration II). The difference between titration II and titration I is calculated as equivalent to the sodium chloride in the sample.

Calculations. The following calculations were used:

$$\% \text{ lactic acid} = \frac{\text{N base} \times \text{mL} \times 90}{\text{sample wt}} \times 100 \quad (1)$$

$$\text{mL titration II} - \text{mL titration I} = \text{mL base equivalent to NaCl} \quad (2)$$

$$\% \text{ NaCl} = \frac{\text{N base} \times \text{mL} \times 58.5}{\text{sample wt}} \times 100 \quad (3)$$

RESULTS AND DISCUSSION

Unfermented juice from cabbage samples varied from 0.19 to 0.29% acid calculated as lactic acid and 0.34 to 0.57% cations calculated as sodium chloride. Accuracy of the method was tested by adding a known amount of sodium chloride to the juice and then analyzing for sodium chloride content by the procedure including the subtraction of the titration for the unspiked sample. Results on 12 successive samples that had 2.50% added NaCl ranged from 2.29 to 2.46% (mean, 2.34%, relative standard deviation 2.28%); the average recovery was 93.4%.

Precision of the sodium chloride and lactic acid analyses were determined from duplicate titrations on 32 samples by one operator over 6 months' time. For lactic acid, the mean value was 1.16% with a relative standard deviation between duplicates of 2.46%. Extremes of amounts found in the samples were 0.56 to 1.83%. For sodium chloride the mean value was 1.82% with a relative standard deviation between duplicates of 2.46%. Extremes of amounts found in the samples were 1.15 to 2.39% sodium chloride.

With a cost of 15 to 20 cents of silver nitrate per determination, the established methods (Brammell, 1971; AOAC, 1975) are more expensive than the method described here. In addition to economy, pollution hazards are lowered by eliminating the use of heavy metals.

Although other uses were not investigated, it is believed the method may have applications in the processing of other fermented foods where salt is added.

ACKNOWLEDGMENT

Most of the analytical determinations were done by Mrs. G. B. Rose. The sauerkraut samples at various stages of fermentation were supplied by the industry and were collected by P. H. Williams, Department of Plant Pathology, University of Wisconsin, Madison, Wis.

LITERATURE CITED

Association of Official Analytical Chemists, "Official Methods of Analysis", 12th ed, Washington, D.C., 1975, p 599.

Brammell, W. S., *J. Assoc. Off. Anal. Chem.* **54**, 56 (1971).

Pederson, C. S., Albury, M. N., "The Sauerkraut Fermentation", New York State Agricultural Experiment Station, Bulletin 824, Cornell University, Geneva, N.Y., 1969.

Cecil H. VanEtten

Northern Regional Research Center
Agricultural Research Service
U.S. Department of Agriculture
Peoria, Illinois 61604

Received for review November 28, 1977. Accepted January 16, 1978. Presented in part at the Annual Corporation Meeting, National Kraut Packers Association, Inc., Madison, Wis., July 20–21, 1977. The mention of firm names or trade products does not imply that they are endorsed or recommended by the U.S. Department of Agriculture over other firms or similar products not mentioned.